"STUDIES ON ASSESMENT OF QUALITY OF PANEER AND PANEER ANALOGUES AND TO DEVELOP AND DESIGN ITS RAPID ADULTERATION DETECTION TECHNIQUES"

A Synopsis for the Degree of

DOCTOR OF PHILOSOPHY IN DAIRY SCIENCE

Submitted to

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

By
Shri. Raju DhondiramAkrupe
M.Sc (Agriculture) in Dairy Science

RESEARCH GUIDE

Dr. Rajkumar Sopanrao Sonwane
Professor & Head,
DEPARTMENT OF DAIRY SCIENCE,
YESHWANT MAHAVIDYALAYA, NANDED

SEPTEMBER-2022

TITLE:

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INTRODUCTION OF THE STUDY

Paneer is a heat-cum-acid coagulated, un-fermented indiandairy product popular in Indian subcontinent and is similar to an un-ripened variety of soft cheese. A widely accepted theory is that like the word itself, Paneer originated in Persianate lands and spread to the Indian sub-continent under Muslim rule Paneer, according to this theory, was developed and molded to suit local tastes under these rulers, and the Delhi Sultanate and Mughal Empire is when paneer as currently known developed. Another theory states that paneer is Afghan in origin and spread to India from the lands that make up Afghanistan*[Food and Agriculture Organization of the United Nations, 1990]*. National Dairy Research Institute states that paneer was introduced into India by Afghan and Iranian invaders *[Robinson and Tamime, 1996]*. Based on texts such as *Charaka Samhita*, BN Mathur wrote that the earliest evidence of a heat-acid coagulated milk product in India can be traced to 75-300 CE, in the Kushan-Satavahana era*[Rao, 1992]*.Paneer is indigenous to South Asia and was first introduced in India by Afghan and Iranian travellers*[Sunil Kumar et al., 2011]*.So that, the term 'Paneer' comes from the word '*peynir*', which just means 'cheese' in the Turkish and Persian Languages.

The Paneeris obtained by heat and acid coagulation of milk, entrapping almost all the fat, casein complexed with denatured whey proteins and a portion of salts and lactose. Paneer is marble white in appearance, having firm, cohesive and spongy body with a close-knit texture and a sweetish-acidic-nutty flavour. Paneer is highly nutritious since it remains about 90% fat and protein, 50% minerals and 10% lactose of the original milk*[Mathur, 1995]*.Paneer is a rich source of animal protein available at a comparatively lower cost and forms an important source of animal protein for vegetarians. Over and above its high protein content and digestibility, the biological value of protein in paneer is in the range of 80 to 86 *[Shrivastava and Goyal 2007]*.The production of paneer has been largely confined to the unorganised dairy sector which employs traditional, inefficient methods of manufacture. Pioneering work for the upgradation of the traditional methods of paneer manufacture was carried out*[Bhattacharya et al. 1971]*.

An estimated 5% of milk produced in India is converted to paneer *[ICMR 2000; Chandan 2007a]* and the production figure being 3,959 metric tonnes in the year 2002–03, which increased to 4,496 metric tonnes in the year 2003–04 *[Joshi 2007; Shrivastava and Goyal 2007]* exhibiting a growth of 13%.According to IMARC Group,the paneer market in India is reached to INR 420.6 billion in 2021 and it expects that the market to reach INR 1,023.4 billion by 2027, exhibiting a growth rate of 16.2% during 2022-2027*[Report of IMARC Group, 2021]*.

Due to the ever-growing demand for paneer, researchers were encouraged to develop new techniques for the manufacture of paneer and the paneer alike products called as Paneer analogues. Researchers recommended varied processing conditions for the preparation of varieties of paneer using different types of milk and the milk like liquid products of non-dairy origin that paved the ways for manufacture the paneer like products resembling to the paneer that now has been emerged as Paneer analogues after the insertation of the definition of term 'Analogue in the dairy context' in the Food Safety and

Standards (Food Products Standards and Food Additives) Regulation, 2011related to the food standards vide amendments dated 12th October,2017and consequently the Paneer analogues will started to be sold in the name of Paneer in the market without following the regulation framed in relation thereto.

The shelf-life of paneer is for a day or two at ambient temperature and for about a week under refrigeration (7°C). The spoilage of paneer is mainly due to bacterial action, so the attempt has been made to enhance the shelf-life of paneer to its largest duration with the useof the techniques of Good Manufacturing Practices (GMP), Good Hygienic Practices and the Hazard Analysis and Critical Control Points (HACCP).

The adulteration in the milk and dairy product is very commonand the possible reasons behind it may include-demand and supply gap, perishable nature of milk, low purchasing capability of customer and lack of suitable detection tests *[Kamthania et al. 2014].* The motivation behind it is economic, but the impact is a real public health concern *[Singh & Gandhi, 2015]* and the paneer, very popular milk product used for preparing snacks, sweetmeats and culinary purposes is not exception the said practice of adulteration.The number of instances of Paneer adulteration in Punjab with an odious mixture of maida, palm oil, baking powder, old discarded skimmed milk, detergent, bicarbonate of soda and suphuric acid is reported in the leading Newspaper the Statesman *[Maneka GandhiEnviornmental Activist, 2018]* and also the instances of paneer adulteration on the same line is also reported in the newspaper from Thane & Palghar*[Business Standard, February 14, 2019]* Mumbai*[The Times of India, May 13, 2022]* and Pune*[Pune Mirror, September 6,202]* of the Maharashtra.

The Parliament of India has enacted the integrated food law named as Food Safety and Standard Act,2006 to consolidates all earlier food laws including Prevention of Food Adulteration Act,1954 relating to food into a single statue and to establish the Food Safety and Standard Authority of India for laying down science-based standards for the food articles and to regulate their manufacture, storage, distribution, sale and import, to ensure availability of safe and wholesome food for human consumption and accordingly the regulation related to the licensing& registration,labelling, food product standards & food additives, laboratory and sampling analysis,Contaminants, Toxins and Residues, Prohibition and Restriction on Sales are issued by the Food Safety and Standard Authority of India stipulating their implementation with effect from the August 5, 2011. The name of aforesaid regulation are as follows;

1. Food Safety and Standards (Licensing and Registration of Food Businesses) Regulation, 2011
2. Food Safety and Standards (Food Products Standards and Food Additives) Regulation, 2011
3. Food Safety and Standards (Packaging and Labelling) Regulation, 2011 [Larer on, superseded by Food Safety and Standards (Labelling and Display) Regulations, 2020]
4. Food Safety and Standards (Prohibition and Restriction of Sales) Regulation, 2011
5. Food Safety and Standards (Contaminants, Toxins and Residues) Regulation, 2011
6. Food Safety and Standards (Laboratory and Sampling Analysis) Regulation, 2011.

At the same time the Central Government has published the rules for carrying out the provisions of this Act under the name of theFood Safety and Standards Rules, 2011.

In view of the above, it is imperative toassessthe Chemical Quality including common adulterants and the Microbiological Quality of Paneer and Paneer analogues in terms of the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011, to ascertain whether the labelling requirements are met by the Paneer and Paneer

analogues as stputed in the Food Safety and Standards (Labelling and Display) Regulations, 2020,also to understand the consumer perception behaviour about the distinction between the Paneer and Paneer analogues sold in the Thane Districtand to suggest the measures to the Food Safety & Standard Authority of India about how to end the adulteration in Paneer by creating public awareness about the distinction between the Paneer and Paneer analogues by suitably amending the concerned regulation andalsoabout the strict enforcement of the provision prescribed under the Food Safety & Standard Act,2006, Rules & Regulation thereunder in relation thereto.

AIMS & OBJECTIVES OF THE STUDY

1. To asses the Chemical Quality including common adulterants of Paneer and Paneer analogues sold in the Thane District in respect of standards prescribed under the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011.
2. To asses the Microbiological Quality of Paneer and Paneer analogues sold in the Thane District in respect of requirements prescribed under the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011.
3. To ascertain whether the Paneer and Paneer analogues sold in the Thane District meets the labelling requirements prescribed under the Food Safety and Standards (Labelling and Display) Regulations, 2020.
4. To understand the consumer perception behaviour about the distinction between the Paneer and Paneer analogues sold in the Thane District.
5. To suggest the measures to the Food Authority about how to end the adulteration in Paneer by designing and developing rapid adulteration detection techniques to detect adulteration in Paneer and Paneer analogues.
6. To recommend to the Food Authority to accept the designed and developed rapid adulteration detection techniques on national level for creating public awareness about the distinction between the Paneer and Paneer analogues and to suitably amend the concerned regulation framed under the Food Safety & Standard Act,2006.

LEGAL SPECIFICATION OF PANEER & PANEER ANALOGUES IN RESPECT OF CHEMICAL QUALITY & MICROBIOLOGICAL REQUIREMENTS

According to theFood Safety and Standards (Food Products Standards and Food Additives) Regulation, 2011, Paneer means the product obtained from any variant of milk**, with or without added milk solids, by precipitation with permitted acidulants such as lactic acid, citric acid, malic acid, vinegar, glucono delta lactone, sour whey and heating with composition of maximum moisture content is 60% for Paneer & Medium Fat Paneer and 70% for Low Fat Paneer with minimum milk fat content is 50% for Paneer, more than 20% & less than 50% for Medium Fat Paneer and less than 20% for Low fat Paneer containing permitted food additives within the limits specified as in the Appendix-A and meets the Microbiological requirments as specified in the Appendix-B of these regulation and 'Low Fat Paneer'/'Medium Fat Paneer' shall be sold in sealed package only bearing declaration of"LOW FAT PANEER" Or "MEDIUM FAT PANEER on the label . The Microbilogical requirements of Paneer in termsthe Appendix-B of these regulation is that Aerobic Plate Count(Total Plate Count) should not be more than 150,000/gm and not more than 350,000/gm, Coliform Count/Staphylococcus aureusshould not be more than 10/gm and not more than 100/gm,Yeast &Mould Count should not be more than 50/gm and not more than 150/gm, Escherichia coli should be less than 10/gm, Salmonella sp. Should be absent /25 gm and the Listeria monocytogenes should be absent per gm.

Acoording to the BIS (1983), Paneer is animportant indigenous milk product prepared by the combined action of acid coagulation and heat treatment of buffalo or cow milk or a combination thereofhaving maximum moisture content of 60%, Minimum Milk Fat of 50%, Maximum titratable Acidity of 0.5%,Maximum Bacterial Counts per gram is 500000, Maximum Coliform Count per gram is 90, and Maximum Yeast &Mould Count per gram is 250 and it should be free from free moisture having pleasant odour& mild acidic flavour with closely knit smooth texture, firm. Cohesive and spongy body.

According to theFood Safety and Standards (Food Products Standards and Food Additives) Regulation, 2011"the Analogue in the dairy context", as referred to in the Regulation 2.1, means a product in which constituents not derived from milk take the place, in part or in whole, of any milk constituent(s) and the final product resembles, organoleptically and/or functionally, milk or milk product or composite milk product as defined in these regulations.

However, the term Dairy analogues, Analogue in the Dairy Context and Paneer Analogues has not specified by the Bureau of Indian Standard.

Moreover, **the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011** has classified all the food productsincluding the Paneer and Paneer analogues into 15 Food Category System therein the Paneer is categorised into the sub-category No. 1.6.1 and Paneer analogues into thesub-category No. 1.6.5.

Although there is extensive research on the Paneer analogues and the mention &definiton of the term, 'Analogue in the dairy context', the food article the Paneer analogues or Dairy analogues has been not standardised in the said regulation by the Food Safety and Standard Authority of India. At the same time, **the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011, explained the term Proprietory Food** is an article of food that has not been standardised under these regulation containing only those ingredients other than additives which are either standardised or permitted for use in the preparation of food products under the Food Safety Standards and Regulations shall use only such additives and at such levels, as specified for the Category or Sub-category under Appendix A of these Regulations, to which the food belongs&Such Category or Sub-category shall be clearly mentioned on the label along with the generic name, nature and composition of the proprietary food and shall use only such additives and at such levels, as specified for the Category or Sub-category under Appendix A of these Regulations, to which the food belongs and also comply with the microbiological requirements as specified in Appendix B of these Regulations. Proprietary food shall also comply with the provisions, as applicable, of all other Regulations made under the Food Safety and Standards Act 2006.

According to the Food Safety and Standards (Labelling and Display) Regulations, 2020 the Pre-packaged food shall not be described or presented on any label or in any labelling in a manner that is false, misleading or deceptive or is likely to create an erroneous impression regarding its character in any respect and the every package shall carry the following information on the label such as Name of Food, List of Ingredients, Nutritional information, Declaration regarding Veg or Non veg Declaration regarding Food Additives Declaration of name and complete address of manufacturer,packer& brand owner, FSSAI logo & license number, Net quantity, Retail Sale Price and Consumer Care details,Lot/Code/Batch identification, Date Marking such as Date of manufacturing/packing & date of Expiry, Declaration regarding Food allergen,logo of fortified food if applicable and the said information should be grouped together and given at one place on the principle display panel of the food product concerned.

As the BIS certification scheme is basically voluntary in nature and the Central Government under various considerations viz. public interest, protection of human, animal or plant health, safety of environment, prevention of unfair trade practices and national security made the Indian Standard compulsory to the products as done in the Milk Powder, Condensed milk, partly skimmed and skimmed condensed milk Sweetened ultra high temperature treated condensed milk Skimmed milk-powder, standard gradekimmed milk-powder, extra grade Partly skimmed milk powderand infant milk substitutes but it is not made compulsory for the Paneer despites having the specification for the same. However, the Food Safety and Standard Act, 2006, rules & regulation thereunder is mandatorily in in nature and binding on all food products including the Paneer and Paneer analogues.

COLLECTION OF THE SAMPLES & LIMITATION OF THE STUDY:

The sample of Paneer & Paneer analogues shall be collected from the retail & wholesale shops operating in the Jurisdiction of the Thane District in terms of the rule 2.1.3 (4) (iii)(d) of the Food Safety and Standard Rules,2011 as per the powers given to the research scholar being Food Safety Officer of the Thane District in the quantity of 250 gm for Paneer and of 500 gm for Paneer analogues as prescribed under theFood Safety and Standards (Laboratory and Sampling Analysis) Regulation, 2011 for the purpose of chemical analysis including the detection of common adulterants and in case of microbilogical requirements the sample of the Paneer & Paneer analogues are drawn in terms of the Table-2 of the Appendix-B of the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011.

REVIEW OF LITERATURE OF THE STUDY: -The work done by earlier research workers have been and are presented in the following points;

Shrestha et.al. (2020) studied the yield & Quality of Paneer from the Combination of Cow Milk and Buffalo Milk and found that the combination of 700:300(Buffalo milk: Cow milk) combination alongwith 80.73°C coagulating temperature and with 1% citric acid solution as cogulating agent gives maximum yield of 165.642 g paneer with 18.28% protein and 58.21 % fat content.

Rajiv Kumar (2021) reported that the recovery of total solids in paneer was significantly increased with the elevation of each fat level of milk and the hike in recovery of total solids with increasing fat levels in milk might be attributed to the increase in fat-protein complexes during heating of milk. However, the recovery of fat is decreased significantly with the increase in each fat level of milk as the increase in fat level in milk had an adverse effect on the recovery fat in paneer.

Hazra et.al. (2020) revealed that Kirschner Value (KV) could not be fruitful for assessing the quality of milk fat in dairy products although chromogenic tests were efficient to detect adulteration of foreign fats in milk fatand further observed that apart from oil, others adulterants like starch urea are predominant adulterants that were detected in market samples of paneer sold by the different dairies in Amreli district.

Bhandekar et.al. (2019) collected the samples of paneer from different regions viz., central, east, west, north and south of Nagpur city and found that the adulteration of starch was more or less found in all region's paneer samples. Whereas, adulteration of coal tar dyes was found in central, west, north and south regions. However, east region paneer gives negative test for coal tar dyes and only two samples give positive test for starch, hence east region paneer found superior over other with respect to starch and coal tar dyes adulteration.

Bhoyar et.al. (2019) examined the samples of paneer from different regions viz., central, east, west, north and south of Gondia city and found that the paneer marketed in

south region had better physico-chemical qualities than east, west and north paneer, which were fair but full fill standards of FSSAI (2006)

Gupta and Bisla (2019) studied the physiochemical, nutritional and sensory characteristics of paneer prepared from coconut milk and found that moisture content the Protein content and ash content of coconut milk paneer is lower than standard's cow milk paneerwhile the fat content of coconut milk paneer is higher than standard's cow milk paneer.

Gogoi and Sultana (2018) revealed that all the samples of paneer sold in Guwahati were contaminated with one or more than one pathogens.The Staphylococcus aureus (30) contamination was commonest followed by Escherichia coli -20(66.7%), Klebsiella pnumoniae -12(40%) and Salmonella typhi-4(13.3%). Among all 80% of samples were found to be contaminated with more than one pathogen – 40% each with 3 and 2 pathogens and 20 % single pathogen.

Sughanya R and Lalitha Ramaswamy (2017) investigated that Paneer made with Coconut milk had higher protein, calcium and iron as compared to standard paneer and can therefore behelpful for people suffering from malnutrition and concluded that an acceptable paneer can be prepared by using cow's milk and coconut milk blend (upto 50% substitution).

Kumar et.al. (2016) evaluated the samples were collected randomly from various shops from different zones of Varanasi city and found that all samples of paneer collected from different parts of the city were highly contaminated with bacteria as well as fungi. All the 15 samples studied had bacteriological counts ranging from 8.082 to 8.135 logCFU/g) and fungal counts ranging from 6.009 to 6.477 logCFU/g. The samples were found to be contaminated with Salmonella and Vibrio in 75.18%, and 24.82% of the samples respectively.

Jadhav B. A. (2016) investigated the paneer prepared from different milk blends were stored at room temperature without and with packaging material for microbial quality with respect to SPC, Yeast and Mould and Coliform. With the enhancement of storage period, SPC and Yeast &mould count increased steadily and gradually at every storage interval and temperature. Coliform was found to be absent throughout the storage. The Paneer becomes mouldy after 3 days and 6 days of storage at room temperature without packaging and with packaging material respectively.

Godbole et.al. (2013) collected the paneer samples randomly from various shops from different zones of Nagpur city. The findings in the present study indicate that all samples of paneer collected from different parts of the city were highly contaminated with bacteria and fungi. All the 32 samples studied had bacteriological counts ranging from 1x106 to 8.2x107 CFU/gm and fungal counts ranging from 1x105 to 6.6x106 CFU/gm. The samples were found to be contaminated with Staphylococcus spp., Salmonella, E.coli in 97%, 34% and 72% of the samples respectively.

Goyal et.al. (2007) attempted to evaluate the physical, chemical and microbial quality of paneer marketed in Agra city and a comparison was made with a control sample and found that the acidity was lowest in control samples, ranged from 0.30% to 0.45% with a mean value of 0.38%, while it was recorded highest in paneer procured from Bijalighar and Bhagwan Talkies, ranges form 0.54 to 0.70% and 0.40 to 0.72% with the mean values of 0.64% and 0.59%, respectively, the yeast and mould count per gram of paneer samples obtained from Shahganj, Sadar, Bijalighar and Bhagwan Talkies markets and control was recorded as 13.00, 96.75, 102.50, 154.50 and 58.75 counts per gram, respectively, the average number of coliform per gram of paneer samples collected from Shahganj, Sadar, Bijalighar, Bhagwan Talkies markets and control were analyzed to the tune of 94.25,

119.25, 104.50, 80.50 and 40.75 counts per gram, respectively and the total viable count of Shahganj, Sadar, Bijalighar and Bhagwan Talkies markets and control ranged from 985.00 to 223.42, 992.50 to 272.69, 1170.00to 234.81, 1042.50 to 255 and 87.50 to 11.90, respectively.

MATERIALS & METHODS:-

(I) The following materials are required for the collection of the sample for chemical & microbiological analysis under this study and to ascertain the consumer perception behaviour regarding the distinction of Paneer & Paneer analogues visiting the premises for purchasing the Paneer.

1. Clean, Dry & Sterile plastic Jar
2. Sample Coding Slips
3. Thick Brown Paper
4. Sealing Wax
5. Thread
6. Copper seal to seal the samples collected
7. Formalin Solution in case of sampling for chemical analysis
8. Questionnaire printed form with serial number
9. Chill Box in case of sampling for microbiological analysis

The sample should be collectedfrom the retail & wholesale shops operating in the Jurisdiction of the Thane District in the manner the retailer & wholesaler sell the Paneer & Paneer analoguesto the ordinary customer and the collected sample will be sealed & packed at the place of collection itself.

(II) The collected sample will be sent to the laboratory recognised by the State Government and or the Food Safety & Standard Authority of India and the sent sample will be analysed by the incharge of the Laboratory in terms of the methods & parameters given under theFood Safety and Standard Act, 2006, rules & regulation with the help of following analytical methods;

a) **For the Purpose of analysis of Chemical Parameters including adulterants**

1. Estimation of Moisture Content: -IS: 2785:1979; Reaffirmed 1995
2. Estimation of Fat Content: IS 2785 -1979 (Reaffirmed 1995)
3. Estimation of Starch: - IS 1479 (Part I) 1961 (Reaffirmed 2003)

b) **For the Purpose of analysis of Microbiological requirements**

1. Estimation of Aerobic Plate Count (Total Plate Count): -IS5402/ISO:4833
2. Estimation of Coliform Count: -5401 Part 1/ISO: 4832
3. Estimation of Staphylococcus aureus: -IS 5887: Part 2 or IS 5887 Part 8 (Sec 1)/ ISO: 6888-1 or IS 5887 Part 8 (Sec 2)/ ISO 6888-2
4. Estimation of Yeast &MouldCount: -IS:5403 or ISO: 6611
5. Estimation of Escherichia coli count: -IS 5887: Part 1 or ISO: 16649-2
6. Estimation of Salmonella sp.: -IS 5887: Part 3/ ISO: 6579
7. Estimation of Listeria monocytogenes: - IS 14988: Part 1/ ISO: 11290-1

However, the manuals of the method of analysis, as amended/adopted by the Authority from time to time including AOAC/ ISO/Pearson's/Jacob/IUPAC/Food Chemicals CODEX/BIS/Woodmen/Winton-Winton/Joslyn, shall be used for analyzing the samples of food articles. In case the method for analyzing any parameter is not available in these manuals, a validated method of analysis prescribed by internationally

recognized/analytical/regulatory agencies, shall be adopted as per the 2.4.2(7) of theFood Safety and Standard Rules,2011.

STATISTICAL ANALYSIS OF COLLECTED DATA UNDER THE STUDY:

TheData obtained under the study has to be complied and applied to the appropriate statistical model to get the accurate outcome of the study.

YEAR-WISE PLAN OF RESEARCH WORK AND THE TARGETS TO BE ACHIEVED

FIRST YEAR		
S.N.	**Name of activities**	**Nature of activities**
1.	Completion of Course Work of Paper-I of Research Methodology, Paper-II of Computer Application and Paper-III of Research Publication & Ethics	S.R.T.M.U, Nanded /Yeshwant Mahavidyalaya Nanded
2.	Collection of references& Review of Literature Writing	V.N.M.K.V. Parbhani/M.P.K.V. RahuriDist Ahmednagar/ Central Library, Nanded and other relevant sources by referring books & reputed scientific journal.
SECOND YEAR		
3.	Completion of Course Work of Paper-IV of Foundation & Philosophy of Research (Based on basic knowledge of core resarch domain) & Paper-V of Paper on research topic(specific)	Yeshwant Mahavidyalaya Nanded &concerned places of Seminar/Conferences/ Symposium/ Workshop/training related to subject
4.	a) Collection of Sample for Purpose of Chemical analysis including adulterants b) Analysis of sample for chemical Parameter c) Study of Consumer Perception Behavoiur through Questionnaire	In the Jurisdiction of Thane District Recognised Laboratory At the respective place where Paneer & Paneer analogues sold
5.	a) Collection of Sample for Purpose of Microbiological analysis b) Analysis of sample for microbiological requirement c) Study of Consumer Perception Behavoiur through Questionnaire	In the Jurisdiction of Thane District Recognised Laboratory At the respective place where Paneer & Paneer analogues sold
6.	Compilation of Data and its Statistical analysis	Yeshwant Mahavidyalaya Nanded/ S.R.T.M.U, Nanded
THIRD YEAR		
7.	Submission of Final Synopsis	S.R.T.M.U, Nanded
8.	Pre Ph.D.-Seminar	Yeshwant Mahavidyalaya Nanded
9.	Thesis Writting	Yeshwant Mahavidyalaya Nanded
10.	Submission of Thesis	S.R.T.M.U, Nanded
11.	Defense to the Research Work (i.e Thesis)	Yeshwant Mahavidyalaya Nanded

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(**Raju DhondiramAkrupe**)
Research Scholar